THE EFFECT OF CO_2 ON THE ABSORPTION OF ALCOHOL AND THE INFLUENCE OF ALCOHOL ON THE DIFFUSION OF CO_3 IN THE SMALL INTESTINE.

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In a former investigation(1) it was shown that CO_2 increased the absorption of alcohol by the gastric mucous membrane in the cat and that the presence of alcohol in the stomach had the curious effect of apparently making the mucous membrane of the stomach permeable in one direction only. The present investigation was undertaken to determine whether these effects were also exhibited by the mucous membrane of the intestine. At the same time the opportunity was presented of making a comparison between the effect of alcohol on stomach and intestine.

Method. The method employed was similar to that in dealing with the stomach. The animal (cat) was anæsthetised with ether and decerebrated or pithed by Langley's starch injection method, artificial respiration being generally applied. Eight inches from the pylorus a piece of gut 55 cm. long was measured and clamped off. At each end a cannula connected with a tap was ligatured into the loop; and the loop was washed out with warm unbuffered Ringer's solution. The upper cannula was connected with a side tube between it and the tap, and through this tube the liquid to be investigated was introduced and kept at a constant pressure of 5 cm. of water.

The basic experiments as in the case of the stomach were done with unbuffered Ringer only. The table given below shows results which enable us to compare the absorption of Ringer only from the stomach

Table I.

	Intestine			Stomach		
	Ringer introduced c.c.	Liquid removed c.c.	Absorption P.c.	Ringer introduced c.c.	Liquid removed c.c.	Absorption P.c.
12	7·8	2·3	70	—	—	—
13	22·6	Trace	100	54·5	56	−1·5
14	15·8	7·4	53	51·5	51·5	0
15	24	18	25	68·2	66	+2·2
16	36·3	7	80	53	53	0

and intestine in the same animal. The intestinal absorption though very variable is always considerable. These experiments are similar in results to those which have been obtained by former observers; the reason we introduce them is that the animals having been either decerebrated or pithed the influence of the anæsthetic is largely eliminated.

Absorption of alcohol in the intestine. The alcohol experiments were done on the same lines as in the case of the stomach only, *i.e.* each experiment consisted of two parts, each part was only of one ½ hour's duration. In (*a*) about 8 p.c. alcohol in unbuffered Ringer was used and in (*c*) the same alcoholic solution to which about 44 p.c. of CO_2 had been added. In some experiments solution (*a*) was used first and then solution (*c*) and in others the solutions were used in the reverse order.

TABLE II.

Exp.		C.c. alcohol absorbed in intestine	P.c. liquid absorbed	P.c. CO_2 at beginning	P.c. CO_2 at end of experiment
1	(*a*)	1·565	76	0	?
	(*c*)	2·38	24	—	?
2	(*c*)	1·53	70	About 44	?
	(*a*)	1·08	10	0	?
3	(*c*)	1·287	31	40	1·7
	(*a*)	1·121	6	0	1·6
4	(*a*)	1·0	16	0	2·0
	(*c*)	1·0	0	43	2·0
5	(*c*)	2·03	62	43	3·9
	(*a*)	1·399	12	0	3·5
6	(*a*)	0·755	Slight secretion	0	1·4
	(*c*)	0·686	,,	43	1·7
7	(*c*)	1·275	16·4	44	1·4
	(*a*)	0·696	Slight secretion	0	1·6
8	(*a*)	1·04	10	0	1·2
	(*c*)	1·11	0	48	1·2
9	(*c*)	1·06	35	0	3·2
	(*a*)	1·06	0	48	2·0
10	(*a*)	0·714	40	0	1·6
	(*c*)	0·513	0	48	2·0
11*	(*x*)	—	11·4	0	1·4
	(*y*)	—	9·3	24	1·9
12*	(*y*)	—	7·2	56	3·1
	(*x*)	—	7·9	0	3·2

* In these experiments no alcohol was used; otherwise they were similar.

From the above table, which presents a sample of the results obtained from numerous experiments, it is clear that as far as CO_2 is concerned either the mucous membrane of the small intestine is acting merely as a passive membrane, or the CO_2 is the result of secretion. We

endeavoured to settle this point by estimating the carbonate ion content of the boiled out liquid, assuming that, if the CO_2 present at the end was some of the gaseous CO_2 introduced, then the liquid on boiling out would have been free of CO_2, whereas, on the other hand, if there was a taking up of baryta after boiling then the CO_2 must have been fixed either as $NaHCO_3$ or Na_2CO_3. It was difficult to estimate the CO_2 after boiling because of the very mucilaginous character of the liquid, but the results, though too unreliable to emphasise figures, suggest that the CO_2 was fixed, probably as $NaHCO_3$. This fact was deduced because the alkalinity of the liquid increased on boiling though the CO_2 decreased. The explanation is, we consider, that a little Na_2CO_3 was secreted by the intestinal mucosa and this then met a large excess of H_2CO_3 in the lumen, $NaHCO_3$ was formed, which on boiling lost CO_2 and the liquid therefore became more alkaline.

With regard to the absorption of alcohol in the presence of CO_2 there seems to be a tendency for more alcohol to be absorbed in the presence of CO_2, though the effect is not nearly so marked as in the stomach.

In the second part of the experiment peristalsis always occurs and usually less alcohol is absorbed, but the difference is less marked when there is CO_2 in the liquid in the last part of the experiment than when it is introduced first.

Restating some of the results already presented in Tables I and II it can be seen that the presence of alcohol has an effect on the actual absorption of liquid.

Absorption of liquid from the intestine.

P.c. absorption in 1 hour		P.c. absorption in successive ½ hours			
		Ringer alone		Ringer + alcohol	
Ringer alone	Ringer + alcohol	1st ½ hour	2nd ½ hour	1st ½ hour	2nd ½ hour
70	25	—	—	—	—
100	16	38	30	25	0
50	31	75	68	20	5
25	20	22	22	27	0
80	37	—	—	—	—

We can conclude that alcohol does not hasten the absorption of liquid; on the contrary, the figures for the absorption of liquid containing alcohol are usually considerably lower than in the case of unbuffered Ringer alone. Moreover, alcoholic absorption seems to slow down the absorption of liquid very rapidly, since in the second part of an experiment with alcohol there is very often no absorption at all, whereas in the second half of an experiment with Ringer alone absorption is nearly

as good as it was in the first half. It might be suggested that the volume of fluid in the intestine does not change in the second half of an experiment with alcohol because secretion balances absorption, but the small amount of carbonate present in the fluid removed indicates that this is not the explanation and that absorption is retarded.

From all these considerations we may conclude that the addition of alcohol to water diminishes its efficiency in quenching the thirst.

SUMMARY.

1. The effect of CO_2 is to increase the absorption of alcohol slightly, though not so markedly as in the stomach.

2. It cannot be stated whether the presence of alcohol affects the diffusion of CO_2 because of the possible secretion of Na_2CO_3 into the lumen.

3. Alcohol appears to retard the absorption of liquid in the intestine.

REFERENCE.

1. Edkins and Murray. This Journal, 59. p. 271. 1924.